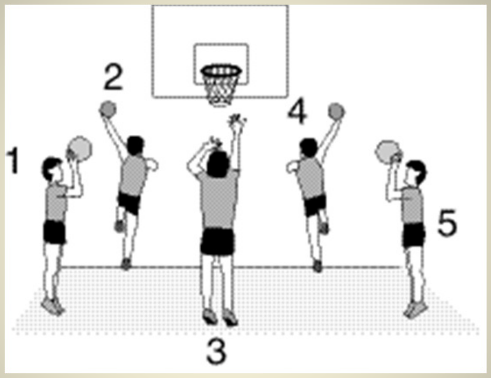
Distribution of learning

Psychology 248
Prof. Benjamin

Blocking vs. interleaving practice



111111333333555555222222444444
or
123451234512345123451234512345

Distributing practice on a balancing skill

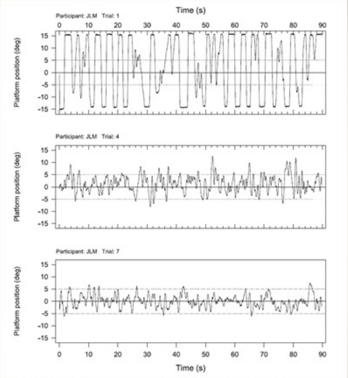
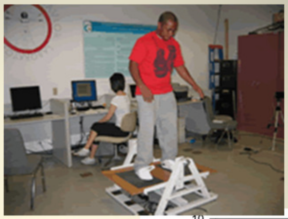
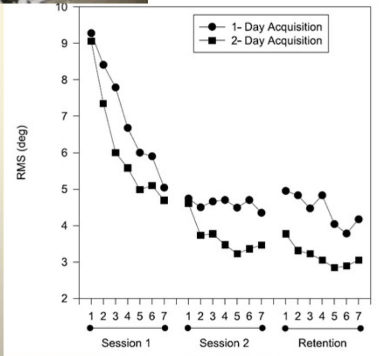


Fig. 2. Examples of stabilometer performance early (top), midway (middle), and late (bottom) in Session 1.

Shea et al. (2000)





Distributed practice in learning to type

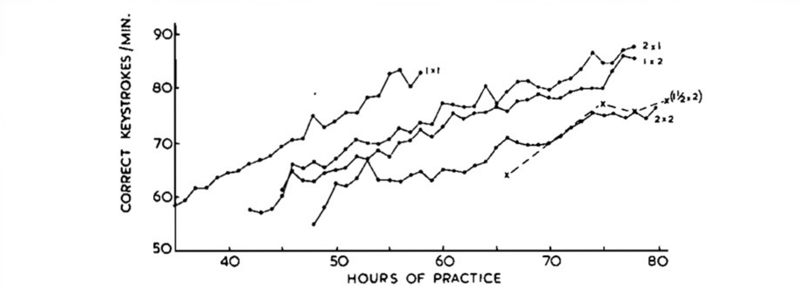
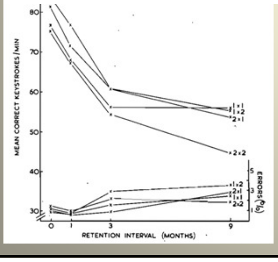
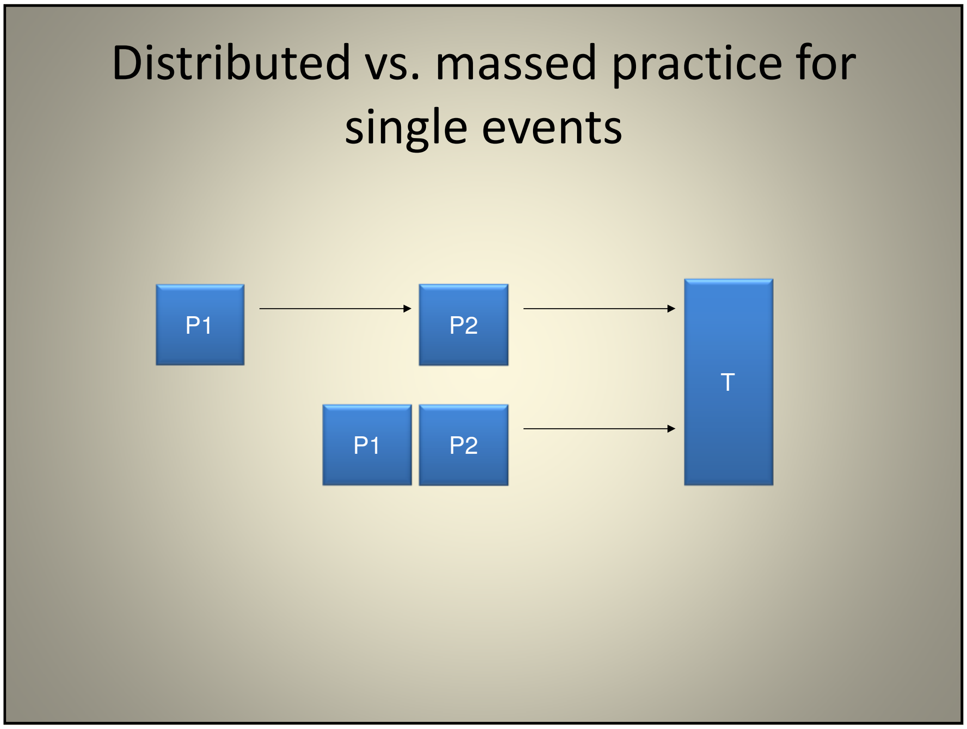


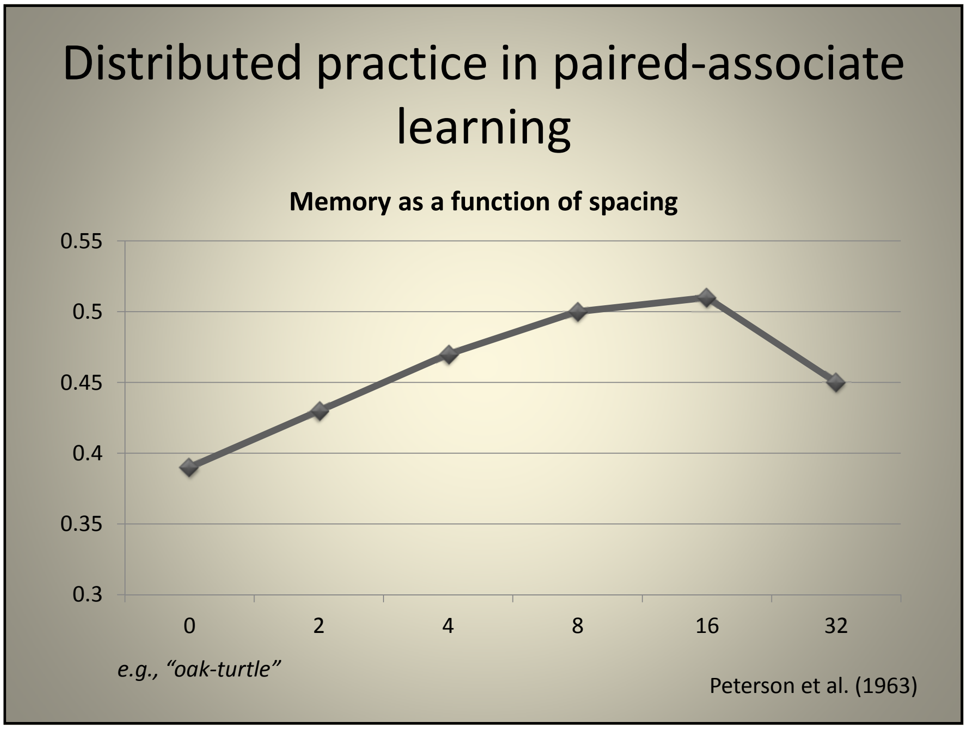
Figure 1. Rate of acquisition of typing skill as a function of training schedule. The 1·5 × 2 function is based on Conrad and Longman's (1965) typewriter group who trained for two sessions of 1·5 h per day.



Baddeley & Longman (1978)



Distributed vs. massed practice for single events



Distributed practice in paired-associate learning

Memory as a function of spacing

e.g., "oak-turtle"

Peterson et al. (1963)

Total Time Law

- All of these results tell us that memory is more than just “time-on-task.”

Optimal distribution of study

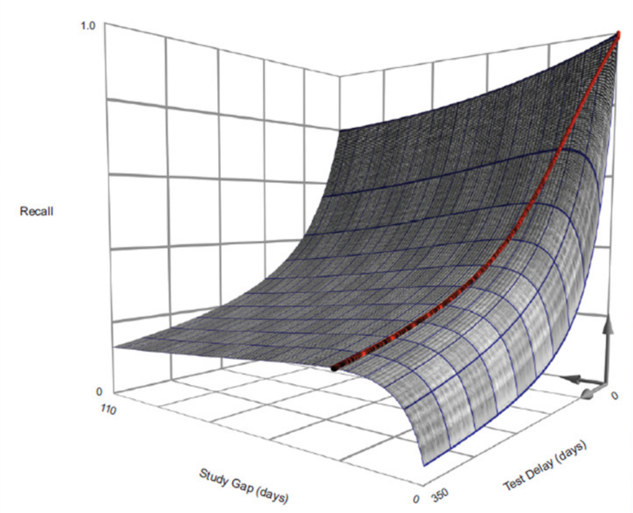


Fig. 4. A functional approximation of recall on the final test (as a proportion), plotted as a function of gap and test delay (i.e., retention interval). The red ridgeline comprises the points representing the optimal performance for each test delay. The forgetting function for each gap is a power function. The location of the ridgeline indicates that as test delay increases, the optimal gap increases, and the ratio of optimal gap to test delay decreases. See the text for parameter values and a fuller description of this surface.

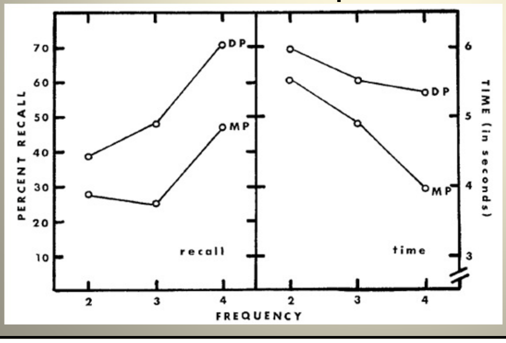
Cepeda et al. (2008)

Theories of why spacing helps

- *Reduced processing* (or attenuation of attention) hypothesis
- *Encoding variability*
- *Reminding*

Reduced processing

- Learning is (voluntarily or involuntarily) reduced when the second presentation is close to the first.
- Evidence from self-paced study time:



Shaughnessy, Zimmerman, & Underwood (1972)

Reduced processing

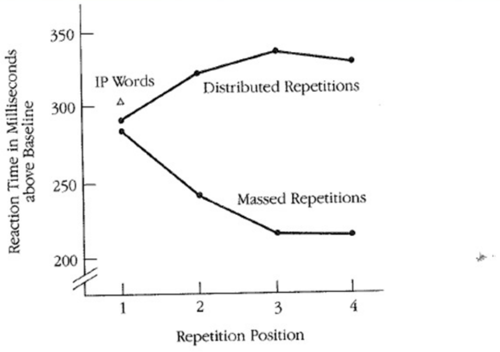
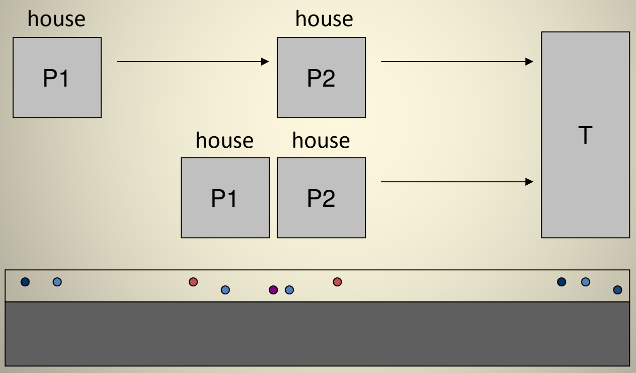
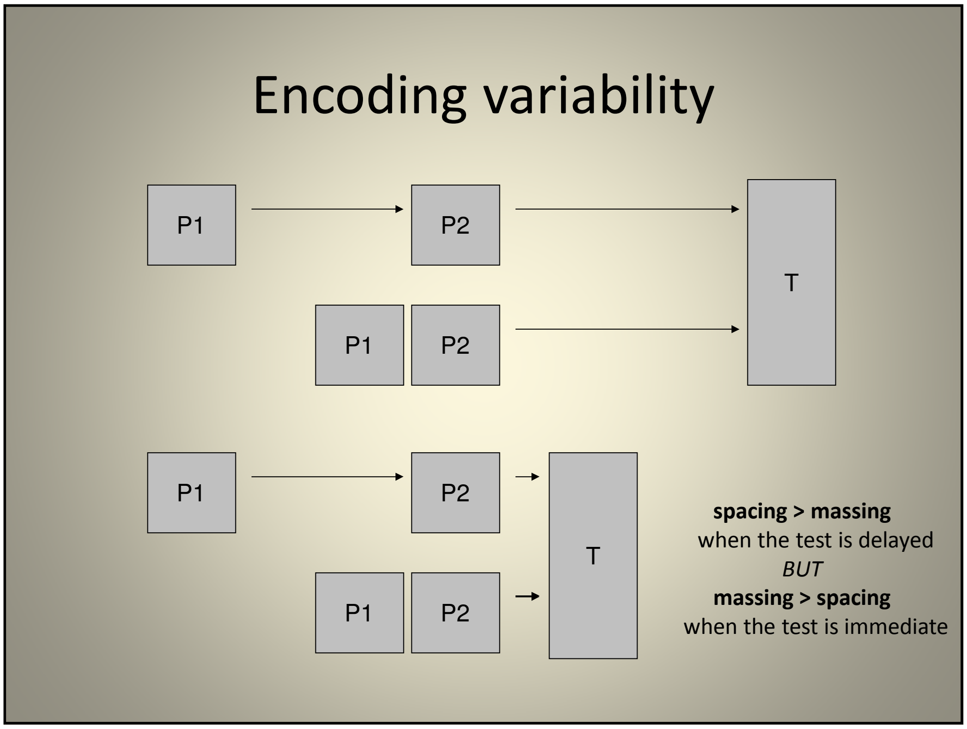


Figure 9-4. Mean reaction time scores for words appearing one time (1P) and for words repeated four times in either a massed or distributed fashion. Reaction times were obtained for each repetition position in the massed or distributed series. *(From "The Contributions of Encoding Effort and Variability to the Spacing Effect on Free Recall," by W. A. Johnston and C. N. Uhl. In* Journal of Experimental Psychology: Human Learning and Memory, *1976,* 2, *153–160. Copyright 1976 by the American Psychological Association. Reprinted by permission.)*

Johnston & Uhl (1976)

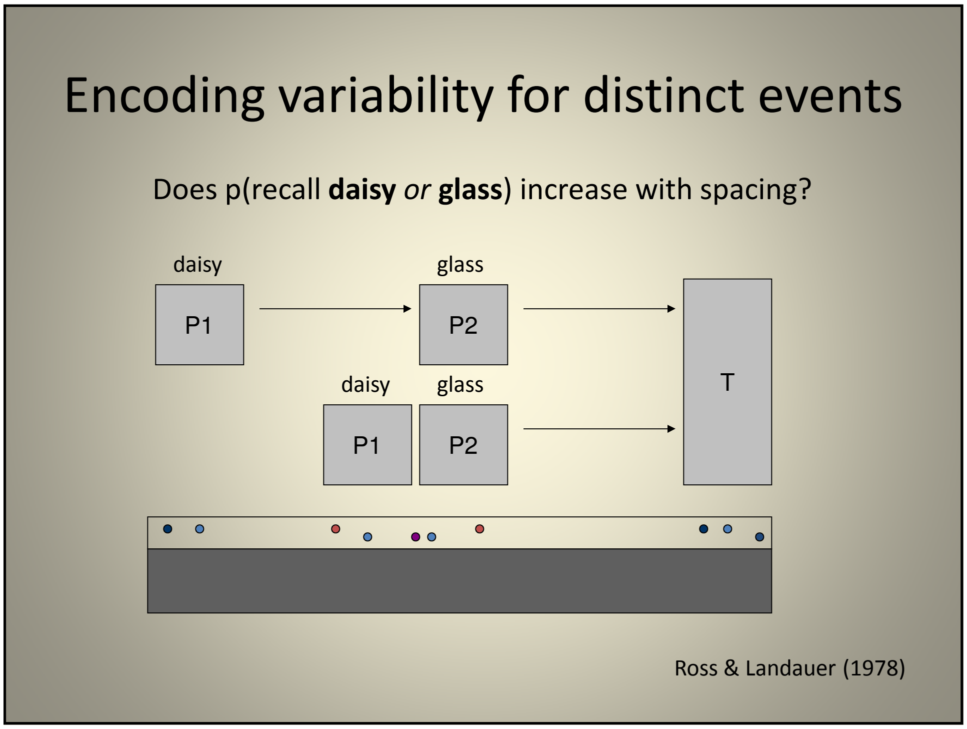
Encoding variability





Encoding variability

spacing > massing
when the test is delayed
BUT
massing > spacing
when the test is immediate

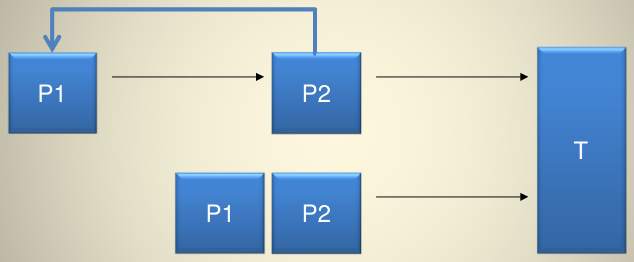


Encoding variability for distinct events

Does p(recall **daisy** *or* **glass**) increase with spacing?

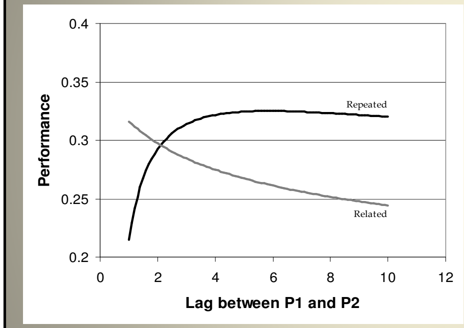
Ross & Landauer (1978)

Reminding theory

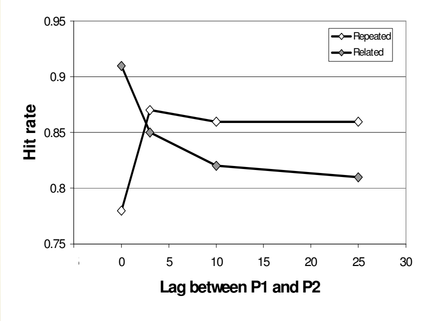


the further P1 and P2 are, the *lower* the chance for reminding
BUT
The further P1 and P2 are, the higher the memory boost when reminding occurs

Reminding theory



Benjamin & Tullis (2010)



Hintzman (1975)

Associates have a lower probability of being reminded, but a bigger boost when reminded.

Expanding retrieval practice

Expanding schedule:
0,3,10 *or* 1,4,10

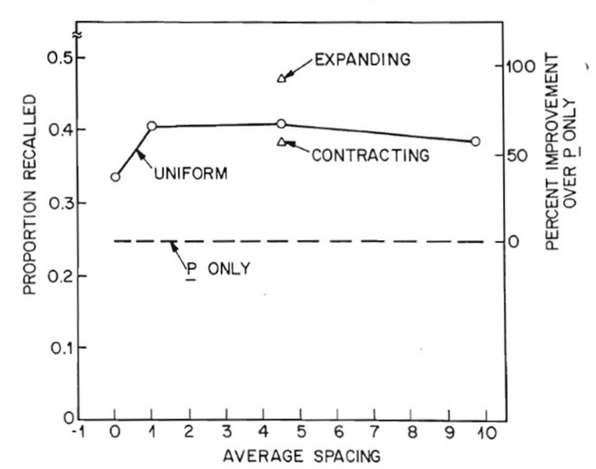


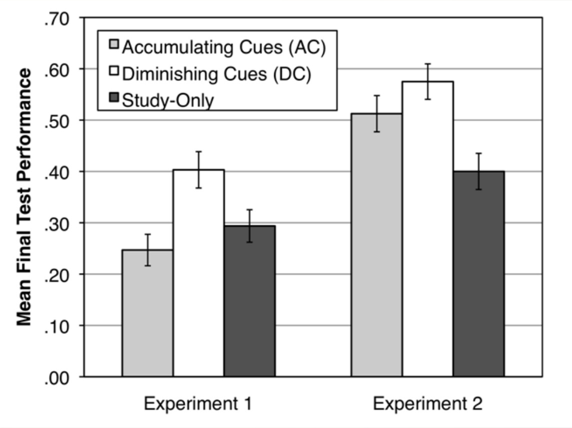
Fig. 2. Exp. I. Performance on final tests. (P – names given only initial presentation).

Landauer & Bjork (1978)

Expanding retrieval practice

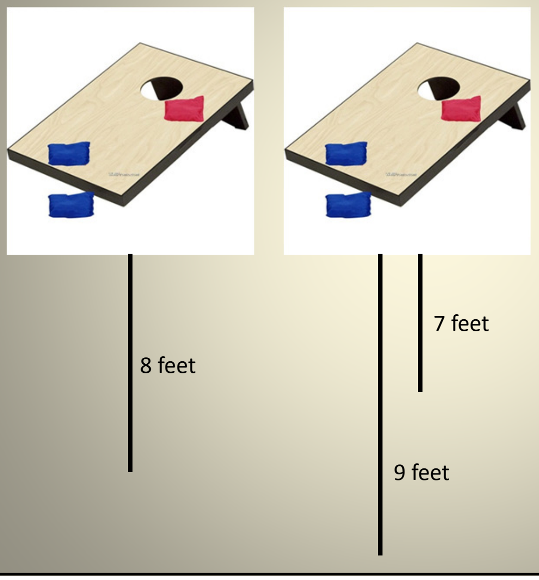
Examples of Practice Trials for the Three Practice Conditions

		Iñupiaq word displaye		
Practice Trial	English word displayed	Accumulating Cues (AC)	Diminishing Cues (DC)	
1	dust -	_ _ _ _ _	a p y u q	
2	dust -	_ _ _ u _	a p _ u q	
3	dust -	_ _ y u _	_ p _ u q	
4	dust -	a _ y u _	_ p _ u _	
5	dust -	a _ y u q	_ p _ _ _	
6	dust -	a p y u q	_ _ _ _ _	



Finley, Benjamin, Hays, Bjork, & Kornell (2011)

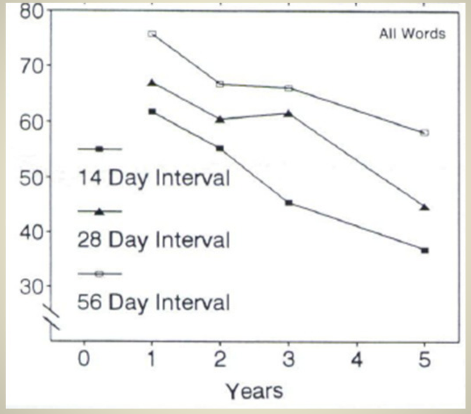
Benefits of variable practice



Test is at 8 feet.

Kerr & Booth (1978)

Long, LONG-term learning



Bahrick, Bahrick, Bahrick, & Bahrick (1993)

Next class:
Production from memory